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(54) **The stabilisation of spraying frames n plant pr tecting machines**

(57) Apparatus for the stabilisation of spraying frames on agricultural machines, has a shaft 2 extending in parallel with the normal travelling direction of the machine. The shaft 2 and the spraying frame 1 are connected via a coupling 6 transmitting axial torque and the torque and movement arising from any axis perpendicular to the shaft 2. Rotation of the shaft causes rollers 8 on arms 9 to run on a contoured track 12 leading to compression of a rubber block 7. Other deflections of the frame 1 are also absorbed and resisted by the rubber block.

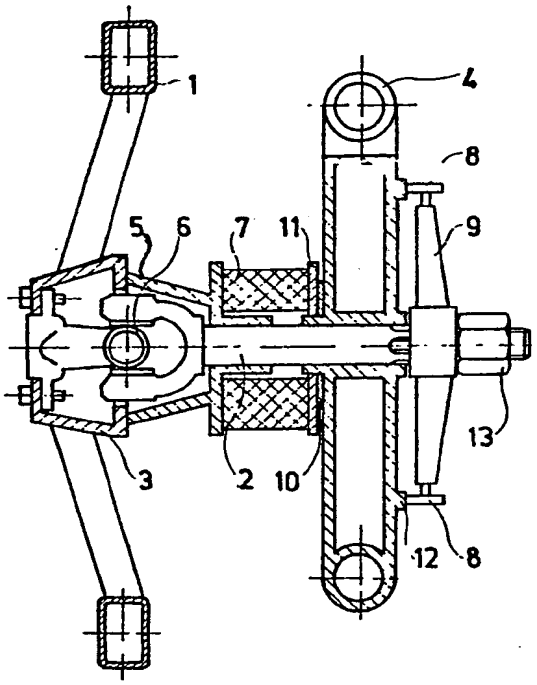

Fig.3

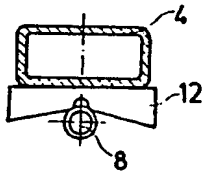

Fig.5

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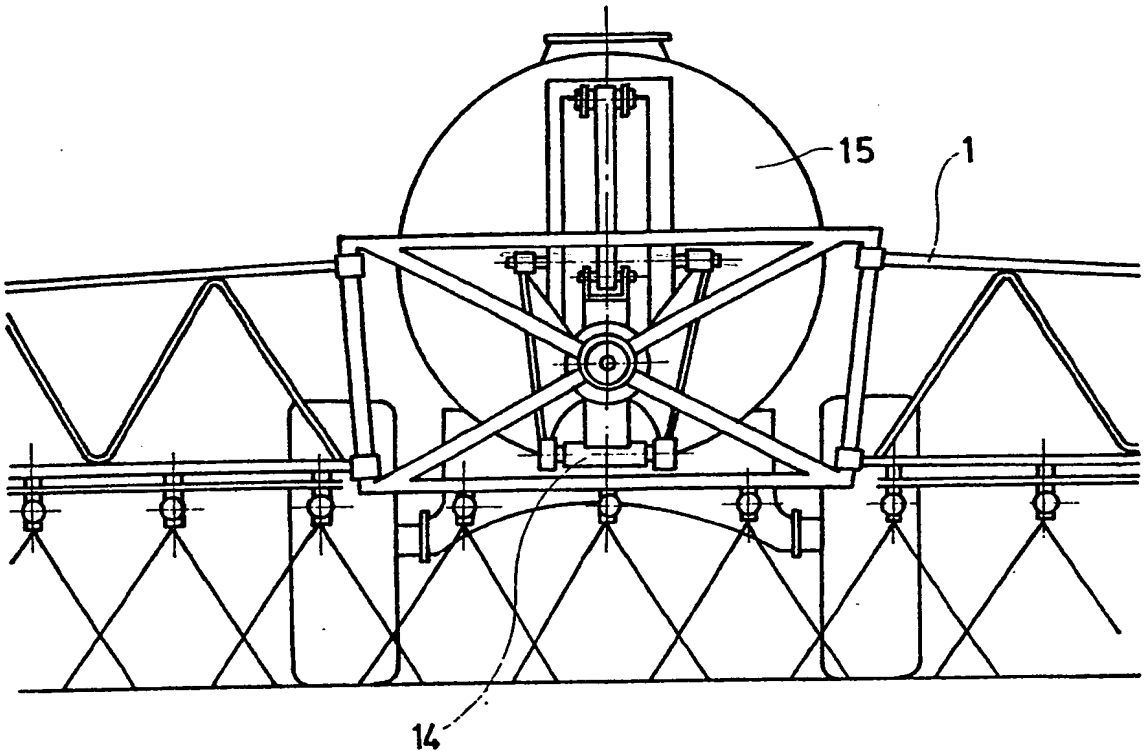

Fig.1

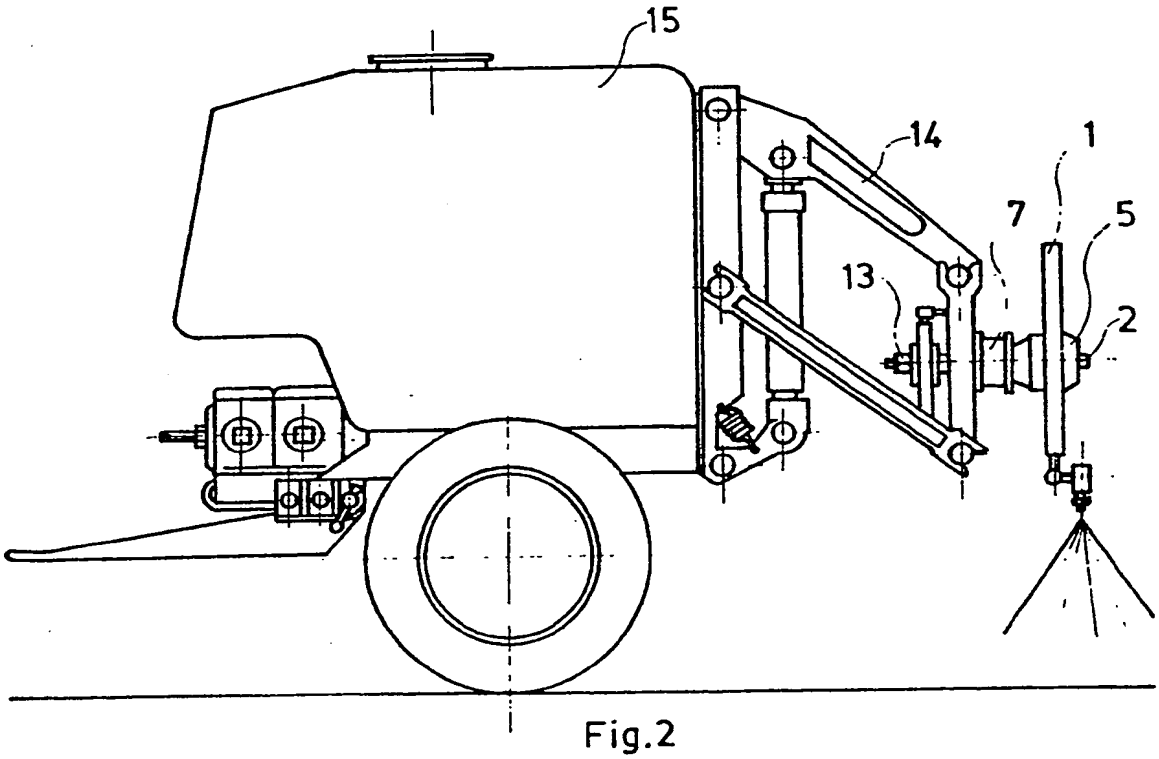

Fig.2

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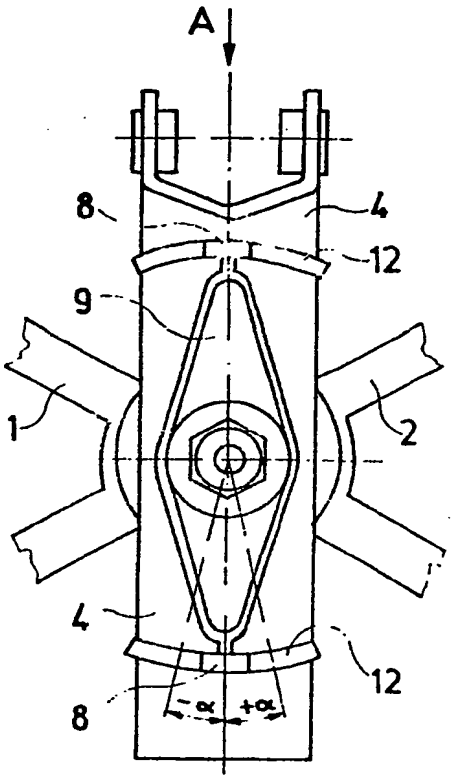

Fig.4

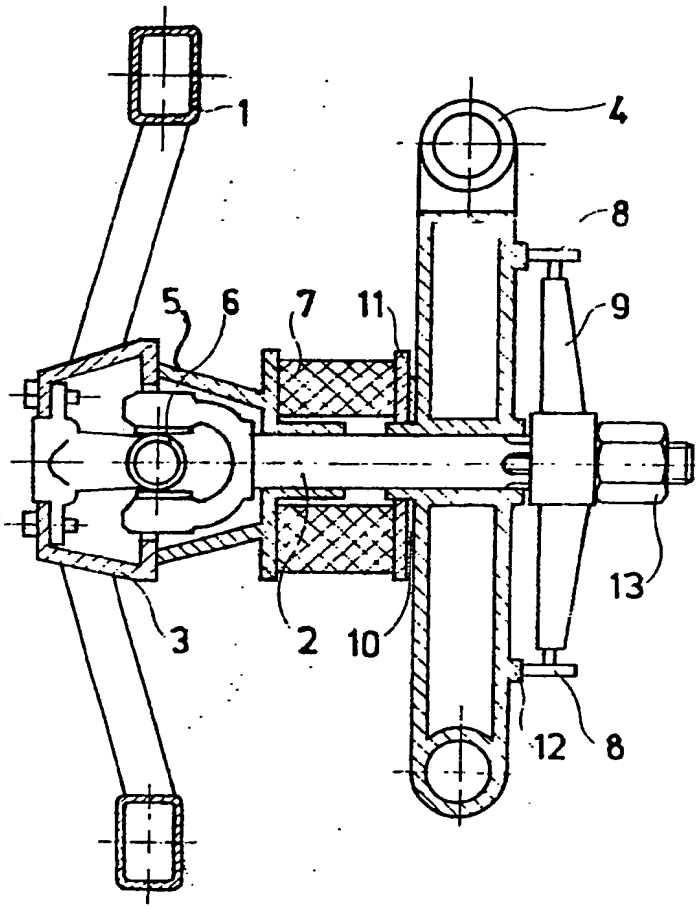

Fig.3

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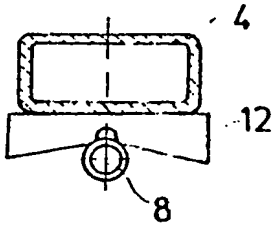

Fig.5

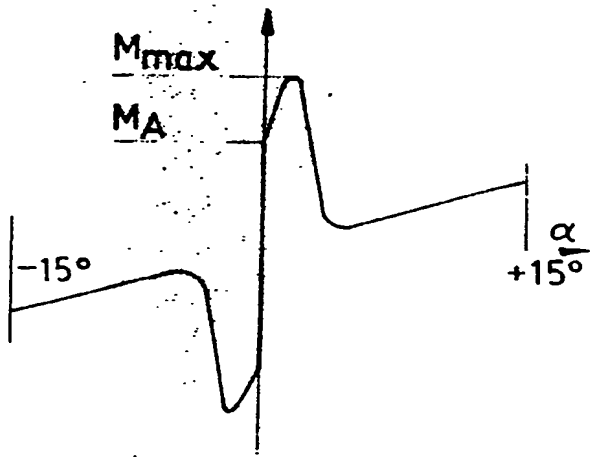

Fig.6

SPECIFICATION

Apparatus for th stabilization f beams suspended in their centre of gravity, particulary for spraying frames on plant protecting machines

The invention relates to an apparatus for stabilization of beams suspended from their centre of gravity, particularly for spraying frames on plant protective (agricultural) machines with bearing supported shaft parallel arranged with the travelling direction.

As known, the method of suspension and stabilization of the spraying frame holding the spraying pipes and nozzles of plant protective machines significantly influences the uniformity of the spraying zone and through the permissible maximum operating speed of the machine it influences the effective area capacity.

Excessive clamping of the spraying frame results in breakage on uneven ground, or in over-dimensioning in order to avoid breakage.

Apart from the spraying constructions towed at low speed on the supporting wheels, the spraying frames with large working width require stabilized connection to the spraying machine.

According to the demand for different operation modes and in order to solve the problem, several constructions of the suspension unit are known. These can be classified according to the position and number of the connecting points.

When the number of rigid connecting points is increased, the control range of the spraying frame is reduced and the induced effects corresponding to the fixed control range are transmitted in the form of a forced coupling.

This recognition is reflected in the single-point connection of the up-to-date suspension units, the known construction of which is based on a shaft or ball-joint.

The spraying frame fixed on shaft has only a single control range, it swings in a vertical plane.

The rigid shaft can be made suitable for use in a horizontal plane by flexible bearings, whereby the control range is increased, but more favourable constructions can be realized with use of ball joints.

Constructions suspended well over the centre of gravity and in the immediate vicinity of the centre of gravity are known according to the position of the connecting point.

The position of the beam suspended well over the centre of gravity is stable, moreover it becomes definitely stable in the stationary position of the machin by use of a pr tensioned resilient unit. This, how v r, does not fit the general interpretation f th stable position, sinc on lateral movement of the machine, positiv performance of the free forces becomes active resulting in dangerous swinging moti n of the spraying frame.

The definitely stable positi n of the spraying frame suspend d at th centre of gravity has to be secured by a separate structural unit, but the position of the spraying frame is independent from the effect of the free forces even on movement of the machine.

As a common shortcoming of the known stabilizing units it may be mentioned that it allows the superimposition of the horizontal and vertical components of the inducing effect transmitted from the basic machine.

The relative horizontal turn arising when the ground is uneven is especially dangerous when a directional change or turn is made by the plant-protective machine, which results in a vertical turn, i.e. in impact of the spraying frame with the ground through the intermediation of the stabilizing units.

However, the horizontal transfer of the vertically inducing component is also disadvantageous, resulting in non-permissible acceleration, measurable at the ends of the spraying frame.

Owing to the mentioned shortcomings, spraying frames of large working width are provided with so-called secondary stabilizing units which allow the deflection of the side wings of the spraying frame—occasionally a certain section of it—against the pretensioned resilient unit.

However, the resilient buffers, slippers, wheels mounted on the ends of the spraying frame intended to eliminate the consequences of inadequate stabilization are of little value.

The invention is aimed at the elimination or reduction of above shortcomings, thus solving the stabilization problem such as to allow the operation of the plant-protecting machines equipped with spraying frames of large operating width even in the case of adverse ground conditions, while the uniformity of the zone of dispersion is preserved.

The invention is based on the recognition that such connecting unit should be used for transmitting the forces from the basic machine acting on the spraying frame which ensures a definitely stable condition in the stationary position of the spraying frame against the inducing force components acting in the horizontal and vertical plane—in accordance with their different characteristics—while on the other hand eliminating superimposition of the inducing force component considerably exceeding the minimal torqu l vel necessary for the vertical stabilization.

The problem posed by the invention is sought to be solved by connecting the bearing supported shaft and spraying frame with a joint transmitting the axial torque and the torqu or movement arising from any axis p rp ndicular to the bearing supported shaft.

Owing to the force transmission, the realization of such a construction is preferred where

the centre of rotation of the joint is in the centre of gravity of the spraying frame.

In order to equalize th forces acting on th spraying frame and especially the dangerous vertical forces, such a construction is preferr d where the bearing supported shaft is provided with a centrally fixed torque-limiting arm converting the turn to axial motion, the two ends of which arm are supported through rollers on a respective forced trajectory track and the forced trajectory tracks are arranged on the framework.

In order to damp the harmful effect of the dynamic force transmission a construction is preferred wherein the joint is connected with the spraying frame through a hub part which rests on a resilient unit, suitably on a ring-shaped rubber block, mounted between a disc and the framework, suitably at the centre of gravity of the spraying frame via said disc slidably embedded on the shaft; furthermore, the shaft is slidably supported in the framework.

The invention is described, merely by way of example, with the aid of the accompanying drawings, in which:

Figure 1 is an elevational view of apparatus according to the invention, shown mounted on a vehicle including a spraying machine,

Figure 2 is a side elevation of the apparatus shown in Fig. 1,

Figure 3 is an enlarged cross-sectional view of the apparatus according to the invention,

Figure 4 is a partial rear elevation of the apparatus according to Fig. 3, looking at it from the spraying machine,

Figure 5 is a view taken along the arrow A in Fig. 4 and showing a forced trajectory track and a roller arranged on it, and forming part of the apparatus; and

Figure 6 is a graph for demonstrating the operational characteristics of a resilient unit, suitably a rubber block, forming part of the apparatus according to the invention.

As shown in Figs. 1 and 2, the preferred embodiment of the apparatus according to the invention is arranged on a lifting mechanism 14 mounted on the rear part of a spraying machine 15. These parts 14, 15 do not form part of the invention, and so they are not described in any detail.

A shaft 2 is arranged for sliding and angular movement within a framework 4 of the lifting mechanism 14, as shown in Fig. 3. A joint or coupling 6 is arranged at one end of shaft 2; it is a universal or cardan shaft coupling in this case, but it may be any other construction allowing similar control possibilities. The joint 6 is conn cted with a conventional spraying fram 1. The joint 6 is arranged at the centre of gravity of the spraying frame 1. The spraying frame 1 may consist of any desired number of members. The spraying frame 1 and the j int 6 are connected through a hub 5. On free end of the hub 5 bears against a disc 3, while its other end is supported by a resilient unit 7. The resilient unit 7 includes a rubber block in this case (buy it may be any other unit suitabl for damped force transmission) and is mounted on a washer 11. In respect of force transmission it is advisable to make the diameter of the part of the hub supported by the flexible unit 7 and that of the washer 11 identical, but greater than the diameter of the rubber block of the flexible unit 7. A washer 10 is arranged between the washer 11 and the framework 4 in order to advantageously influence the friction arising between said units, the material of washer 10 having a low frictional coeffficient. In order further to reduce the friction, the diameter of the washer 10 is smaller than that of the washer 11. The seating position of the washer 11 on the framework 4 is polished and lubricated, thus further reducing the friction. The shaft 2 is arranged in a bore in the framework 4 which bore is similarly lubricated. The part of the shaft 2 passing through the framework 4 is formed with grooves or splines along a certain length thereof projecting beyond the framework 4, to be connectible to a torque-limiting arm 9 formed similarly with grooves in a way suitable for force transmission on this part. The torque-limiting arm 9 is actually a rocker equipped with rollers 8 at its ends. The rollers 8 are rotatably mounted on the torque-limiting arm 9. The rollers 8 engage in a track 12 so as to move along a forced trajectory. The forced trajectory track 12 is a circular arc, the cross-section of which is suitably V-shaped. The middle part of the forced trajectory track 12—as shown in Fig. 5—is formed so as to recieve the rollers 8 in the stationary position. The end of shaft 2 extending beyond the torque-limiting arm 9 is threaded and a nut 13 is engaged on the thread. It is expedient to apply a counter-nut (not shown) securing the nut 13 in order to avoid the risk of it getting loose.

By suitable selection of the track elements, an extremely favourable resultant spring characteristic according to Fig. 6 is assured for the resilient action of the vertical swinging motion of the construction, i.e. the spraying frame 1 is kept in a definitely stable position by the large retaining moment (M_A); on the other hand, when the swinging motion is set off the system becomes soft instead of the usually progressive, hardening spring characteristic, whereby inducing the beam at a much lower energy level.

The operation f the apparatus according to the inv ntion is described in the following, by way of example only.

When a force perpendicular to the operation position acts on one side of the spraying frame 1, then the torque generated is transmitted via joint 6 to shaft 2, which attempts to turn the torque-limiting arm 9

bearing against the forced trajectory track 12. When the rollers 8 arranged at the ends of the t rque-limiting arm 9 move off from their stationary position on the forced trajectory track 12 due to the torque effect, then they move on an identical gradient. The movement of the rollers 8 on the gradient produces tractive forces on shaft 2 through the torque-limiting arm 9 causing the shaft to slide in the framework 4, whereby the spraying frame 1 approaches the framework 4. On the other hand, this movement results in pressure transmission by the spraying frame 1 to the resilient unit 7 through the hub 5 and the disc 3. The resilient unit 7 transmits the pressure to the framework 4 through washers 10 and 11. Pressing apart the resilient unit 7 causes the spraying frame to return into the position where the rollers 8 are also in a stationary position, i.e. they settle in the recesses of the forced trajectory track 12.

When the spraying frame 1 turns vertically downwardly as a result of the force effect, then the rollers 8 remain in their stationary position on the forced trajectory track 12, but the joint or coupling 6 is angularly displaced downardly. This displacement results in a pressure transmitted by the spraying frame 1 to the resilient unit 7 through hub 5 and disc 3.

The resilient unit 7 compressed on one side transmits the force effect to the framework 4 through washers 11 and 10. In the course of this force-transmitting process, naturally the shaft 2 does not move. As soon as the force bringing about the movement and acting on the spraying frame ceases, the resilient unit 7 presses back the spraying frame into its original position.

If the spraying frame 1 turns horizontally, i.e. parallel with the ground, then it is compressed on the side of the resilient unit 7. This compression and equalization take place similarly to the former case.

As a matter of fact, the movement of the spraying frame 1 occurring as a result of the force effect is not of an individual character, but multi-directional movements are brought about. Such composite movements can always be broken down to movements along the described planes, thus equalization of the complex movements takes place as described in the foregoing. This is possible, because the torque is also converted to pressure with the aid of the built-in joint 6, shaft 2, torque-limiting arm 9 and forced trajectory track 12. It is to be mentioned that in order to eliminate the uneven surfaces of the ground and assembly, etc., the use of nut 13 is advisable. Th nut 13 can be pre-tensioned for any ground surface. The apparatus according to the invention can b individually adjust d as well with the nut 13 for any operating condition by changing the pretensioning of the resilient unit 7. In order to maintain the correct adjustment with th nut 13 it is advisable to use a counternut. By using a screw joint with a counternut the vibrations caused by the spraying machine 15, and in the case of turning movement of the shaft 2—caused by the turn of the spraying frame 1 along the vertical plane—no change in the position set by the nut 13 can occur.

Use of the apparatus according to the invention naturally everywhere is possible, where the spraying frames, beams, etc. hav to be continuously stabilized during operation.

In view of above, the apparatus according to the invention is significantly simpler than those known so far, connected with many weight equalizing units. It is producible at low cost, no special production technique or basic material or special maintenance are required. The apparatus is applicable for any known spraying frame type or machine without any difficulty.

CLAIMS

1. Apparatus for the stabilisation of beams suspended in their centre of gravity, particularly for spraying frames on plant protective machines, provided with a shaft arranged in parallel with the travelling direction of said machine, in which the bearing supported shaft and the spraying frame are connected by a coupling or joint for transmitting axial torqu and the torque or movement from any axis perpendicular to the said shaft.

2. Apparatus as claimed in claim 1, wherein the centre of rotation of the joint or coupling is at the centre of gravity of the spraying frame.

3. Apparatus as claimed in claim 1 or 2, wherein the said shaft is provided with a centrally fixed torque-limiting arm for converting angular displacement to axial movement, the two ends of the arm being supported through a respective roller that co-operate with forced trajectory tracks arranged on a framework.

4. Apparatus as claimed in any preceding claim, wherein the coupling or joint is connected with the spraying frame through a hub part which rests on a resilient unit, e.g. a ring-shaped rubber block mounted between a disc and a framework, suitably at the centre of gravity of the spraying frame, through the disc, slidably embedded in the framework.

5. Apparatus as claimed in any preceding claim, wherein said shaft is slidably journalled in the framework.

6. Apparatus substantially as herein described with reference to and as shown in the accompanying drawings

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